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Question: 1

Clearance of low-molecular-weight molecules by dialysis is accomplished mostly by:

A. convection.
B. diffusion.
C. adsorption.
D. solvent drag.

Answer: B

Explanation:
The volume of blood that can be cleared of a given solute per unit time is referred to as clearance (K). The clearance for a given solute is given by the manufacturer based on blood and dialysis flow rates: membrane characteristics: and the molecular weight, size, and charge of the solute. Most low-molecular weight solutes are removed during dialysis by diffusion from the high-concentration to the low-concentration side of the membrane with the rate also dependent on temperature. Large molecules tend to cross the membrane by convection (solvent drag). The sieving coefficient (SC) indicates the amount of solute passing through the membrane with the rest rejected or adsorbed. Thus, an SC of 0.4 predicts that 40% of a given solute will pass through the membrane. Mostly small proteins are removed from the blood by adsorption to the membrane, although cellulose membranes tend to absorb more than synthetic hydrophobic ones. Membranes with adsorbed material are more biocompatible but may diminish diffusion and convection.

Question: 2

A hollow fiber dialyzer has which of the following properties?

A. Very fine fiber tubes held in place by polyurethane material
B. Fibers about I cm in width
C. A high-membrane compliance
D. A high resistance in the fibers, enhancing ultrafiltration pressure

Answer: A

Explanation:
A hollow fiber dialyzer holds thousands of fiber tubes through which the blood flows. They are surrounded by dialysate, separated by the membrane. The blood and dialysate flow in opposite directions, a so-called countercurrent mechanism, which enhances molecular exchange. This is because the concentration gradients are little changed from one end of the fiber to the other. The hollow fibers are very thin but rigid so that the membrane compliance (deformability or volume change) is low. Ultrafiltration rates are predictable so that precise amounts of fluid removal may be

accomplished. The hollow filters have a low resistance to blood flow so that there is not much volume difference at low and high pressure.

Question: 3

Synthetic membranes have which of the following properties?

A. They are cellulose membranes in which hydroxyl groups are replaced with acetate
B. They have thick fiber walls
C. They have poor adsorption
D. They remove solute by diffusion only

Answer: B

Explanation:
Dialysis membranes may be of three types: cellulose, modified cellulose, and synthetic.
Cellulose membranes have thin fiber walls, and solutes pass through them mostly by diffusion. The molecular cutoff is low, about 3000 daltons, so that intermediate-size molecular passage (e.g., beta:-microglobulin at 11,800 daltons) is limited. They are also the least biocompatible of the three types since adsorption is limited. Modified-cellulose membranes have the hydroxyl groups of the molecule replaced by acetate, amino acids, or other synthetic molecules. Their adsorption is improved, and diffusion, convection, and adsorption of solute are better than cellulose. The most effective membranes are purely synthetic made of polymers (e.g., polysulfone, polymethacrylate) formed into hollow fibers with thick walls. These membranes can remove solute up to 15,000 daltons in size, and their adsorption is quite good, leading to an improved biocompatibility.

Question: 4

If a dialyzer has a urea clearance rate (K) of 200 mL/min and a blood flow rate (Qb) of 300 mL/min, what volume of the blood will be cleared of urea in 1 minute?

A. 100 mL
B. 200 mL
C. 300 mL
D. 500 mL

Answer: B

Explanation:
A dialyzer's clearance rate for a particular solute indicates the volume of blood from which the solute will be removed per unit time. It is usually expressed as a K value in mL/min. Thus, with a K of 200 mL/min for urea, 200 mL of the 300 mL blood flowing through in 1 minute will be cleared of urea in 1 minute. Of course, blood is continually recirculated through the dialyzer so a considerable amount of urea may be removed. Blood flow rate (Qb) may be increased to lessen the time of dialysis, but there is a rate limit due to the amount of blood that can flow through the needle in the patierfs vascular access. Dialysis flow rate (Qd) may also increase clearance but to a lesser

degree.

Question: 5

To determine the most accurate clearance rate of a particular solute, one should:

A. use water instead of blood.
B. use a large-molecular-weight molecule.
C. reduce the manufacturer's stated rate by 10%.
D. measure the solute concentrations of blood going into and out of the dialyzer.

Answer: D

Explanation:

The manufacturer's stated clearance for a particular solute is based on laboratory analysis of watery fluids that only approximate the rheological properties of blood. The actual value may differ by ± 10%–30%. Urea is the solute most frequently employed. The true clearance may be calculated by measuring the concentration of the solute going in and coming out of the dialyzer. The formula for dialyzer solute clearance is: $K = (Cb_i - Cb_o)/Cb_i \times Qb$, where K is the clearance, Cb_i is the inlet solute concentration (arterial), Cb_o is the outlet solute concentration (venous), and Qb is the blood flow in mL/min. Increasing the dialysate flow rate (Qd) may slightly improve the solute clearance, but this is not a part of the formula.

Question: 6

All of the following substances are added to the dialysate EXCEPT:

A. bicarbonate.
B. chloride.
C. sodium.
D. phosphate.

Answer: D

Explanation:
The dialysate composition contains ions and glucose in concentrations similar to those of the blood. Usually concentrates are prepared: acid (contains sodium, potassium, magnesium, calcium, chloride, and glucose) and bicarbonate buffer. Acetic acid is added to the acid solution to adjust the PH. The two concentrates are then mixed and diluted with treated water. The concentrates come in three different formulations so it is important to mix the compatible ones. The final concentrations of the ions are adjusted, depending on whether one wishes to raise or lower their blood concentration. Thus, for a hyperkalemic (high potassium) patient, one might not add any potassium or keep it lower than the blood concentration. Phosphate is not routinely added to the dialysate.

Question: 7

Sodium modeling refers to:

A. changing the concentration of the dialysate sodium during the course of dialysis.
B. injecting sodium chloride directly into the patient's vein.
C. adjusting the sodium concentrate of the dialysate with normal saline.
D. none of the above.

Answer: A

Explanation:
Usually sodium concentration in the dialysate is kept the same or similar to that of the blood: 135-145 mEq/L However, higher concentrates are sometimes used at the outset to drive sodium into the blood and raise its concentration. This then enhances an osmotic fluid shift from the interstitial space into the blood and accelerates fluid withdrawal. Then the sodium concentration is slowly reduced during the course of the dialysis, a process called sodium modeling. Caution must be used when performing this procedure since increased thirst and hypertension may result. The physician usually prescribes the concentration of sodium and the speed with which it is reduced.

Question: 8

Conductivity is best defined as:

A. a method of checking electrolyte levels in the dialysate.
B. the voltage required to maintain the dialysis pump to achieve a given flow rate.
C. a monitor and alarm system to measure dialysate flow rate.
D. something that is measured once to check the final ionic concentrations of the dialysate.

Answer: A

Explanation:
Conductivity refers to an electrical method of measuring the electrolytes in the dialysate. Most dialysis units have two conductivity meters, one for the initial concentrate mixture and one for the final dialysate. Electrodes or sensor cells may be employed to measure the current generated by the ionic strength of the solution. The conductivity is monitored in a so-called redundant fashion so that two monitors are used to protect patient safety. Alarms and automatic bypass systems warn of errors in the dialysate composition, and the fluid is diverted to a drain before reaching the patient. Low conductivity is the most common cause of alarm, usually due to low-concentrate levels. A high-conductivity alarm may indicate poor water flow to the proportioning system, untreated incoming water, or use of the wrong dialysate concentrate.

Question: 9

Which of the following statements about the proportioning system is correct?

A. The concentrates are mixed manually

B. It relies on a continuous supply of fresh concentrate and treated water
C. The concentrates are heated after mixing
D. Fixed-ratio mixing is the only method used

Answer: B

Explanation:
Dialysate is made by mixing treated fresh water with concentrates containing the appropriate salts and glucose. The exact amounts of water and concentrate to be mixed depend on the dialysis center and the needs of a particular patient. There must be adequate volumes of water and concentrate for the entire procedure. Mixing of concentrate and water may be accomplished by two different methods: (1) by fixed-ratio pumps in which a diaphragm or piston pump delivers water and concentrate, according to a preset formula: or (2) by a servo-controlled mechanism in which the proportions of water and concentrate are automatically adjusted based on the conductance of the mixture, which is set to a prescribed level.

Question: 10

An advantage of high-flux dialysis is:

A. small pore size.
B. fast removal of fluid.
C. retention of beta2-microglobulin in the blood.
D. slow blood flow, leading to more efficient removal of toxic substances.

Answer: B

Explanation:
High-flux dialysis is a new, more efficient method of hemodialysis than the conventional method. The dialyzer has larger pores for more rapid removal of uremic toxins. Because of the large pores in the membrane, this method can remove larger molecules than the traditional method, for example beta:-microglobulin, which is thought to contribute to arthritis in uremic patients and predisposes to amyloid deposition. The dialysis procedure can also be speeded up by increasing the blood flow to 450 mL/min, which is not possible in the traditional method. Speeding up the rate of flow of the dialysate is also possible. The unit contains an ultrafiltration controller device to regulate the volume of fluid removed from the patient from very small amounts up to 4 L/hr.

Question: 11

A disadvantage of high-flux dialysis is:

A. acetate must be used instead bicarbonate buffer.
B. membrane biocompatibility is reduced.
C. c, pyrogen reactions are common.
D. post-dialysis fatigue is common.

Answer: C

Explanation:
Bicarbonate buffer is used for the dialysate since the acetate previously used caused vasodilation and hypotension. Immunologic reactions and fluctuations in the white blood cell count are less common since the membranes used are more biocompatible. Pyrogenic reactions in high-flux dialysis are common, causing fever and discomfort for the patient and sometimes require hospitalization for observation. This may be because the high-flux membranes have larger pores that allow fragments of bacterial particles to pass into the blood. Such pyrogens have been found in the dialysate. Generally, patients experience less post-dialysis fatigue and may in fact feel better because of the more efficient removal and shorter dialysis times.

Question: 12

All of the following statements regarding home dialysis are true EXCEPT:

A. a spouse's or other family member's assistance is desirable,
B. a visiting dialysis nurse may be employed.
C. the patient and assistant must train for 6—8 weeks,
D. it cannot be done during sleep.

Answer: D

Explanation:
Some patients may choose to have dialysis at home rather than adhere to a fixed schedule at a center. This is often true of people still employed, although some centers do night dialysis. In general, a spouse or other family member must be available to assist the patient. Both patient and assistant must undergo training for 6—8 weeks. Some vendors that supply home-dialysis equipment may also supply a visiting dialysis nurse if no home-based assistant is available. Most centers do not have night schedules, and food is not permitted during the procedure. At home, the end stage renal disease patient may snack during dialysis and even undergo the procedure during sleep, ifthere is an assistant who remains awake. The flexibility of home dialysis appeals to many patients, but some patients feel more secure at a dialysis center.